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AUTHOR Shinn, Mark; And Others
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ABSTRACT

Two studies were conducted to (1) analyze the subtest characteristics of the Woodcock-Johnson Psycho-Educational Battery, and (2) apply those results to an analysis of 50 fourth grade learning disabled (LD) students' performance on the Battery. Analyses indicated that the poorer performance of LD students on the Woodcock-Johnson Tests of Cognitive Ability, as compared to their performance on the Wechsler Intelligence Scale for Children-Revised, can be explained in terms of the kinds of behaviors sampled in the Woodcock-Johnson Battery. Implications of the findings for assessment and placement decisions are discussed such as the possibility that the Battery measures achievement rather than ability. (Author/DB)

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University of Minnesota

Research Report No. 38

A THEORETICAL ANALYSIS OF THE PERFORMANCE OF LEARNING DISABLED STUDENTS ON THE WOODCOCK-JOHNSON PSYCHO-EDUCATIONAL BATTERY

Mark Shinn, Bob Algozzine, Douglas Marston, and James Ysseldyke

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Institute for Research on Learning Disabilities

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I. Adequacy of Norm-Referenced Data for Prediction of Success

II. Computer Simulation Research on the Assessment/Decision-making/Intervention Process

III. Comparative Research on Children Labeled LD and Children Failing Academically but not Labeled LD

IV. Surveys on In-the-Field Assessment, Decision Making, and Intervention

V. Ethological Research on Placement Team Decision Making

VI. Bias Following Assessment

VII. Reliability and Validity of Formative Evaluation Procedures

VIII. Data-Utilization Systems in Instructional Programming

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Mark Shinn, Bob Algozzine, Douglas Marston, and James Ysseldyke

Institute for Research on Learning Disabilities

University of Minnesota

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Abstract

Two studies were conducted to (a) analyze the subtest characteristics of the Woodcock-Johnson Psycho-Educational Battery, and (b) apply those results to an analysis of LD students' performance on the Battery. Analyses indicated that the poorer performance of LD students on the Woodcock-Johnson Tests of Cognitive Ability, as compared to their performance on the WISC-R, can be explained in terms of the kinds of behaviors sampled in the Woodcock-Johnson Battery. Implications of the findings for assessment and placement decisions are discussed.

A Theoretical Analysis of the Performance of Learning Disabled Students on the Woodcock-Johnson Psycho-Educational Battery

The recent development of the Woodcock-Johnson Psycho-Educational Battery (Woodcock & Johnson, 1977), a measure of cognitive ability, scholastic aptitude, academic achievement, and both scholastic and non-scholastic interest, has generated considerable attention among diagnostic personnel. Because all components of the Battery are standardized on the same population, enabling users to overcome one of the problems in computing deficit scores (i.e., contrasting pupil performance on devices normed on different populations), the test has achieved widespread use in identification of learning disabled students.

The Battery contains 27 subtests organized in three separate but related parts. Part One contains 12 "cognitive ability" subtests, Part Two consists of 10 "scholastic achievement" subtests, and Part Three contains "five subtests that measure a subject's level of preference for participating in scholastic or nonscholastic activities" (Woodcock, 1978, p. 1). Performance on the Battery may be reported in typical derived scores (e.g., grade scores, percentile ranks, etc.) as well as by "newer types of interpretation options" (i.e., normal curve equivalents and relative performance indices).

The Battery was developed using the Rasch model of test development, and scores most often are expressed as "W-scores," special log transformations, or Rasch ability scores. The recommended units of analysis are "cluster scores," formed by weighted combinations of subtest scores.

Several investigators have recently reported the results of studies contrasting the performance of learning disabled students on the Woodcock-Johnson Cognitive Ability Battery and their performance on the Wechsler Intelligence Scale for Children - Revised (WISC-R). A consistent finding has been the significantly lower performance of LD students on the Cognitive Ability Battery than on the WISC-R. Using a sample of 51 school-identified learning disabled students (43 males, 8 females), Reeve, Hall, and Zakreski (1979) compared performance on the WISC-R and the Battery's Cognitive Ability subtests. They were interested in the concurrent validity of one portion of the Battery for 7 to 11 year old LD students. They reported several interesting findings. First, the correlation of the two test performances (i.e., .79) was the same as that reported by Woodcock (1978). Second, the LD students' "cognitive ability" as measured by the Battery was approximately one standard deviation below that as measured by the WISC-R. Similar findings were reported by Ysseldyke, Shinn, and Epps (1980). In that study, "cognitive abilities" of 50 school-identified LD students (40 males, 10 females) were again compared. The correlation between performance on the Battery and WISC-R was .67; mean performance on the Battery was approximately 8 points lower than that on the WISC-R.

While both studies provided similar results, explanations for differences in the performance of learning disabled students differed. For example, Reeve et al. (1979) hypothesized three explanations for their results. First, they suggested that the Battery assesses areas of cognitive functioning "in which children with learning problems have greater difficulty than children from the standardization sample"

(p. 68). From the analysis of their subjects' performances, they concluded that the particular area was the Battery cluster of Perceptual Speed; learning disabled students in their sample scored much lower on that cluster than on any of the other clusters. Reeve et al. (1979) offered two other hypotheses: (a) that the norms for the standard scores are in error, and (b) that scoring errors could have resulted in the performance differences.

Ysseldyke et al. (1980) proposed an alternative explanation for the finding of differential performance on the two tests. First, they observed no difference in performance on the Perceptual Speed cluster. Taking into account the fact that the different clusters, and indeed different subtests, sample different kinds of behavior, they interpreted their findings as consistent with the theoretical conceptions of tested "intelligence" postulated by both Cattell (1963) and Newland (1971). Ysseldyke et al. hypothesized that the only aspects of "inferior" performance demonstrated by LD students were on cognitive subtests that fit Cattell's definition of measures of "crystallized intelligence" and Newland's definition of "product-dominant measures."

The behaviors sampled by the "cognitive" subtests of the Battery are listed in Table 1. As is the case with most tests, earlier items within a subtest contain less difficult content than later ones. For example, the "sentences" [sic] which must be repeated in the Memory for Sentences subtest range from "Big house.", "Down the hill.", "Come with me.", to "Emergency employees may be called any time throughout the day to provide extra manpower or whenever the city needs it" (items 1, 2, 3, and final). A student's performance on any given subtest is seen

as the function of an interaction between the kinds of experiences the student has had and the kinds of behaviors sampled by the test. The behaviors sampled by the tests differ in content and in their psychological demand.

Insert Table 1 about here

This research was conducted to ascertain the extent to which the subtests that comprise the Cognitive Battery meet the criteria specified for measures of "crystallized intelligence" or "fluid intelligence" and to examine the performance of LD students from that theoretical perspective. Two separate but related studies were completed. First, an analysis of the subtest characteristics of the Battery was completed; then, those results were applied to an analysis of LD students' performance on the Battery

Study One

Method

In discussing fluid (process dominant) and crystallized (product dominant) intelligence, Cattell (1963) suggested that they differ "on their age trend plots for the general population, gf (fluid intelligence) reaching an early maximum at 14-15 years, while gc (crystallized intelligence) to 18, to 28, or beyond, depending on the cultural learning period for the given subculture" (p. 3). Marston and Ysseldyke (in press) recently completed the development of subtest norms for the Cognitive and Achievement portions of the Battery. In developing these norms they developed growth curves for W-scores for subjects ages 3 to 35 in

the normative sample. Using both Cattell's and Newland's conceptions of tested intelligence, we reasoned that the slopes of measures of crystallized intelligence (product) should be like those for achievement measures (i.e., continuing to rise toward age 30), while the slopes of measures of fluid intelligence (process) would reach an early assymptote. The slope for each subtest in the Battery between the ages 14 and 30 was computed.

Results

The mean W-scores at 14 and 30 years as well as the obtained slope for scores between those ages are presented in Table 2. In general, the slopes of the achievement subtests are higher than the ability subtests, ranging from 1.36 (Word Attack) to 3.88 (Letter Word Identification) with a mean of 2.47. The slopes of the growth curves between age 14 and 30 for the ability subtests range from .38 (Visual-Auditory Learning) to 2.56 (Quantitative Concepts) with a mean of 1.40.

Insert Table 2 about here

An analysis of the overlap among the subtests indicated that the six "ability" measures have slopes above the lowest achievement subtest slope (i.e., 1.36). Slopes for Analogies (1.44), Numbers Reversed (1.69), Picture Vocabulary (1.88), Antonyms/Synonyms (2.25), Visual Matching (2.38) and Quantiative Concepts (2.56) were similar to those of several achievement subtests. In fact, only five achievement areas (i.e., Passage Comprehension, Dictation, Spelling, Computation, and Letter Word Identification) were observed to have slopes greater than that for Quantitative Concepts. Graphic representations of the growth curves (i.e., W-score distributions) for the Visual-Auditory Learning, Quantitative Concepts,

and Letter-Word Identification subtest performance are presented in Figures 1-3.

Insert Figures 1-3 about here

Study Two

Method

Subjects. Fifty fourth-grade children (40 males and 10 females) identified as learning disabled by placement teams in their school districts were the subjects in this portion of the research. The average standard score achievement level for this group, obtained from the Peabody Individual Achievement Test (PIAT) total score, was 91.9 (SD = 8.78) and indicated low achievement. The average intelligence test score for this group, as indicated by the Wechsler Intelligence Scale for Children - Revised was 100.04 (SD = 12.45). Subjects were selected for participation in the present study within six months of their identification as learning disabled. This restriction in subject selection was used in order to reduce the potential effect of receiving special education services.

Data collection procedures. Psychoeducational assessments of the youngsters were made as part of a larger study (cf. Ysseldyke, Algozzine, Shinn, & McGue, 1979) comparing the test performance of learning disabled students to that of a group of 49 low achieving non-learning disabled students. Data from other standardized tests in the domains of achievement (Peabody Individual Achievement Test, Stanford Achievement Test--mathematics computation and mathematics concepts subtests), and perceptual-motor functioning (Bender Visual-Motor Gestalt Test, Developmental

Test of Visual-Motor Integration), were collected concurrently. Students were tested in either three or four one and one-half hour sessions.

For this analysis, the performance of the learning disabled students on the "ability" subtests of the Battery was compared to the normative group's mean performance at the same grade level for each subtest. The mean W-scores for grade 4.8 were used on all subtest comparisons.

Standard scores with a mean of 100 and a standard deviation of 15 are probably more familiar than Woodcock's recently developed W-scores and thus allow a better basis for comparison. For this reason, the subtest W-scores of the learning disabled subjects in our sample and the mean W-scores of the reference group were converted to standard scores ($\bar{X}$ = 100, SD = 15).

Results

The means and standard deviations for the standardized ability subtest scores of the learning disabled children are presented in Table 3; also indicated are the t test results for comparisons made between this sample and the normative group. In all cases, except one, the subtest performances for the LD children were below the mean of 100; the mean performance for Blending, the exception, was 106.38. However, for the remaining 11 subtests, the means for the LD group ranged from 87.26 to 99.36. It should also be noted that the subtest standard deviations of the LD group all approximate the norm group standard deviation of 15; they range from 10.7 to 19.2.

Insert Table 3 about here

To compare the LD group's performance with that of the norm group

on each subtest, a t test analyzing the mean differences was conducted for each of the 12 comparisons (see Table 3). Since the sample size was large (50 subjects) and because of the moderate number of t tests involved, it was decided to use a fairly stringent significance level (.01) in an attempt to insure that any differences found would be more reliable. An analysis of the results suggested that those subtests on which the LD group performed significantly lower than the norm group were Quantitative Concepts, Antonyms-Synonyms, Analogies, and Memory for Sentences. On three of the six tests which appeared to be product dominant, the learning disabled students scored significantly lower than the norming sample.

Discussion

In contrast to the standardization sample, learning disabled students earn relatively low scores on the Cognitive Battery of the Woodcock-Johnson Psycho-Educational Battery. The observed difference is best interpreted as a function of the kinds of behaviors sampled by the subtests, and makes sense when viewed within the theoretical perspectives on tested intelligence postulated by both Newland and Cattell.

Clearly, if the Battery is as sensitive to lack of achievement as it appears, then the measure of "cognitive ability" appears to stack the deck against children with learning problems. Many "average" students who take this test may look like they have low ability.

Most of the clusters of the Battery, composed in each case of a unique combination of differentially weighted subtests, have at least one of the product dominant subtests included in them. For example, the Reading Aptitude cluster consists of the Visual-Auditory Learning,

Blending, Antonyms-Synonyms, and Analogies subtests. A poor performance on either defining word opposites and equals (Antonyms-Synonyms) or on knowing word meanings and relationships (Analogies), or both, would result in a poor Reading Aptitude score. Thus, low achievement looks like low ability. Of critical importance is the student's performance on the Antonyms-Synonyms subtest. It not only is weighted on the Broad Cognitive cluster, but also on the Math, Knowledge, and Written Language, as well as the Reading Aptitude clusters. In addition, it forms a portion of the Verbal Ability and Reasoning clusters.

In summary, the relatively low performance of LD students on the Battery may be accounted for by the subjects' below average performance on achievement oriented subtests. Unfortunately, this works to the disadvantage of learning disabled students, and may result in considerable confusion in making placement decisions. Woodcock (1979) has explained the lower performance of LD students on the Battery relative to their performance on the WISC-R by saying that the Battery is more closely related to achievement. Indeed, this may be the case considering the important role that the achievement-loaded subtests play in the Battery. One must question what it is that the cognitive portion of the Battery measures, achievement or ability.

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Table 1

Behaviors Sampled by Subtests in the Woodcock-Johnson

Tests of Cognitive Abilities

Subtest	Behavior
Picture Vocabulary	Given a graphic representation of an object, the subject must say its name.
Spatial Relations	Given a common geometric figure divided into parts as a model, the student must select its component parts from a number of alternatives.
Memory for Sentences	Given an orally presented sentence, the subject must repeat it back to the examiner.
Visual-Auditory Learning	Given a series of meaningless symbols, the subject must say particular words for each of them.
Blending	Given orally presented phonemes, the subject must say them together to make a word.
Quantitative Concepts	Given graphically or orally presented stimuli, the subject must respond with the answer to questions about mathematics, general information, symbols, abbreviations, and perform some calculations.
Visual Matching	Given a page of series of numbers in rows, the subject must circle the ones that are the same in each row. (Timed)
Antonyms-Synonyms	Given a visually and orally presented word, the subject must in one part give a one-word answer for a word that means the same as a stimulus word and in the other part give a one-word answer that means the opposite of a stimulus word.
Analysis-Synthesis	Given a key of colored boxes, the subject must use the key to tell which color box completes a puzzle.
Numbers Reversed	Given a series of orally presented digits, the subject must say them in reverse order.
Concept Formation	Given a puzzle consisting of colored, different sized geometric shapes, the subject must specify a rule (size, color, shape) that forms the basis for inclusion in that puzzle.
Analogies	Given three visual and orally presented words, the subject must say the one word that completes the analogy.

Table 2

Slopes of Growth Curves Between Ages of 14 and 30 Years

on Subtests of Woodcock-Johnson Psychoeducational Battery

	Mean W-Score at 30 yrs.	Mean W-Score at 30 yrs.	Slope
Tests of Cognitive Ability			
Visual-Auditory Learning	505	511	.38
Blending	505	514	.56
Spatial Relations	509	520	.69
Analysis/Synthesis	509	522	.81
Concept Formation	513	529	1.00
Memory for Sentences	515	535	1.25
Analogies	518	541	1.44
Numbers Reversed	515	542	1.69
Picture Vocabulary	518	548	1.88
Antonyms/Synonyms	521	557	2.25
Visual Matching	530	568	2.38
Quantitative Concepts	529	570	2.56
Achievement Tests			
Word Attack	506	528	1.36
Humanities	518	545	1.69
Science	516	544	1.75
Proofing	517	551	2.13
Social Studies	524	559	2.19
Usage	522	560	2.38
Punctuation	518	557	2.44
Applied Problems	522	561	2.44
Passage Comprehension	520	562	2.63
Dictation	535	583	3.00
Spelling	522	571	3.06
Calculations	534	586	3.25
Letter-Word Identification	531	593	3.88

Table 3

Converted Subtest Means and Standard Deviations of LD Group[a]

Subtest	Mean	SD	t
Visual-Auditory Learning	99.36	10.7	- .42
Blending	106.38	12.3	3.68
Spatial Relations	96.00	13.0	-2.16
Analysis-Synthesis	98.57	14.2	- .71
Concept Formation	96.82	15.8	-1.42
Memory for Sentences	87.26	19.2	-4.70*
Analogies	93.18	13.9	-3.47*
Numbers Reversed	97.10	16.9	-1.21
Picture Vocabulary	97.98	13.9	-1.02
Antonyms-Synonyms	91.14	15.8	-3.96*
Visual Matching	95.79	13.4	-2.22
Quantitative Concepts	90.87	14.6	-4.42*

[a]Also included are test comparisons with norm group.

*$p < .01$

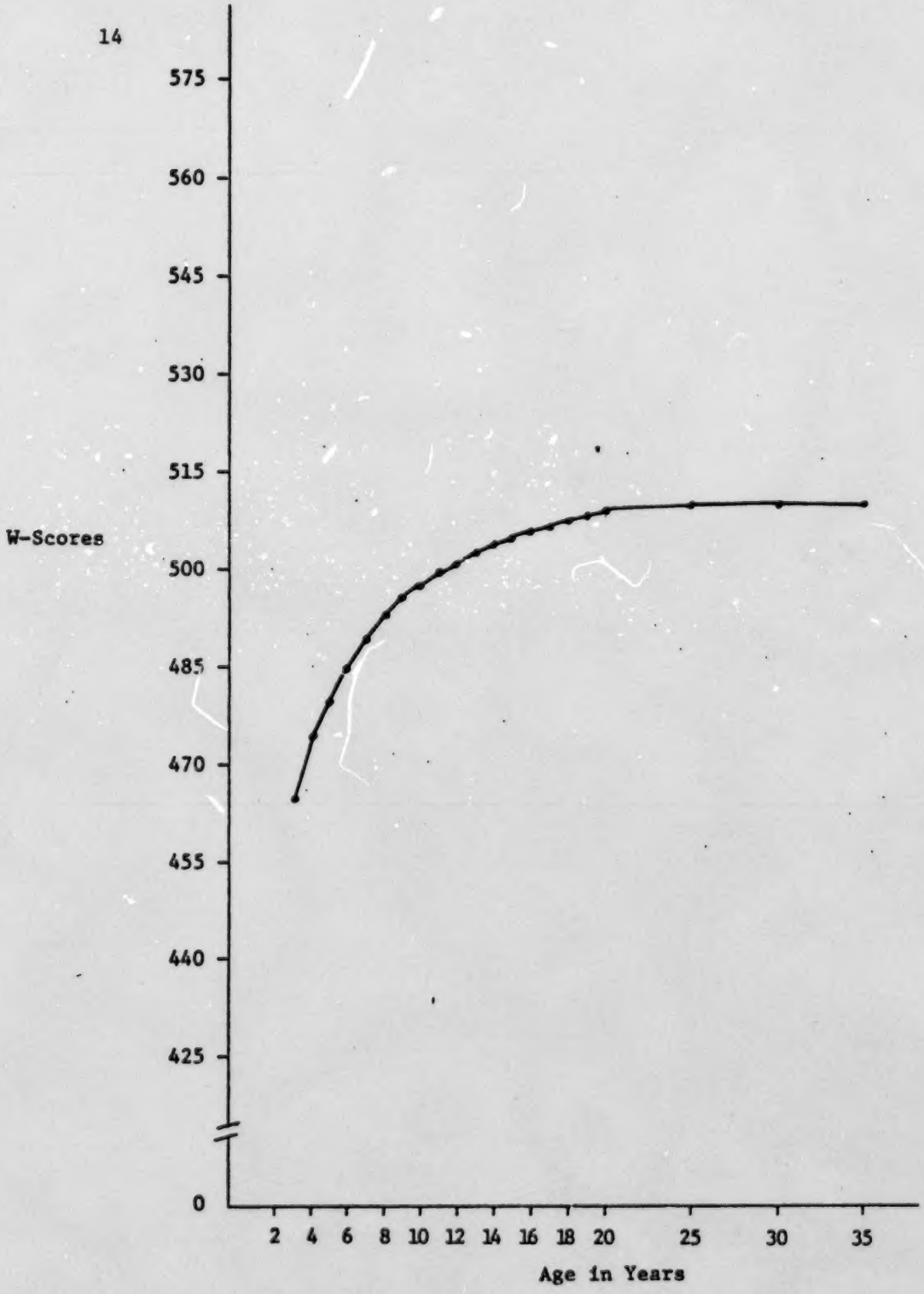

Figure 1. Growth curve for Visual-Auditory Learning Subtest from normative sample.

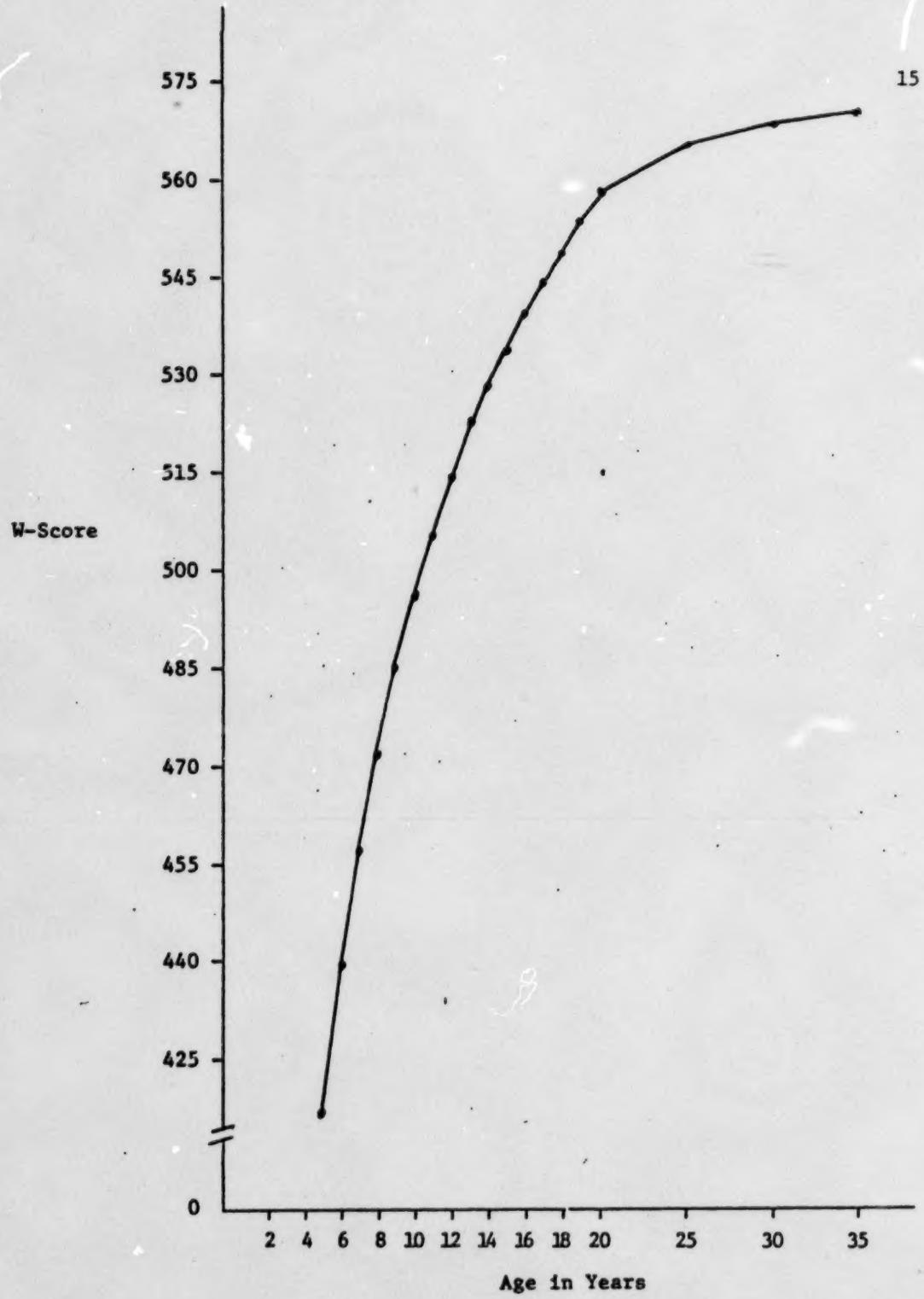

Figure 2. Growth curve for Quantitative Concepts Subtest from normative sample.

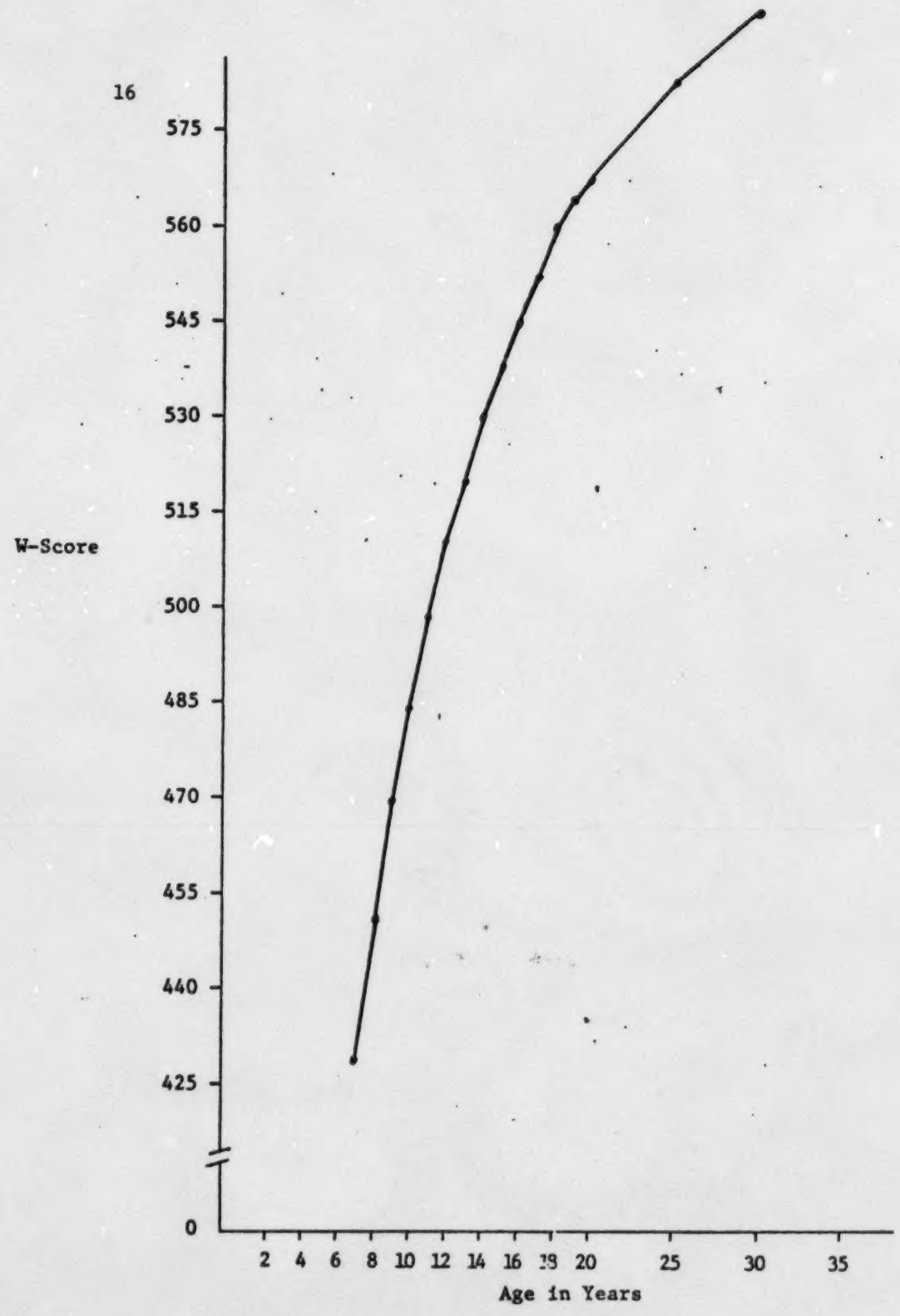

Figure 3. Growth curve for Letter-Word Identification Subtest from normative sample.

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